1: Coon E-5 (1926-1927) 1931 MX3 Rif MX3

delta. The course of the Ghis slants southwestward from Targuist, while the Nekor flows directly northward through sharp canyons from the mountain of Kuin in Gzennaya, to separate, farther along, Temsaman and Beni Tuzin from Beni Urriaghel. On the other side of the promontory of Temsaman empties the Amkaran, or Wed el Kebir, which commences a short distance away in the mountains of Beni Tuzin. Next to the Amkaran lies an unimportant stream called the Tasagin, coming down from the Dhar O Baran in Beni Ulishk. Beyond this there are none but the important arteries of the Kert and the Muluya, the former of which originates in Gzennaya, the seeming umbilicus of the Rif, and the latter of which flows northward from distant Tafilelt, where its head lies near that of the Draa, a lengthy watercourse emptying into the Atlantic nearly opposite the Canary Islands.

Such is the catalogue of rivers, the waters of which are jealously guarded and conserved, and which have been the cause of many of the local wars in the Rif.

The mountains of the Rif are supposed to be fabulously rich in minerals, including coal, iron, gold, and petroleum. None of these, however, have been extracted by the present inhabitants of the country, and hence they do not concern us here. Suspicion engendered by the presence of the minerals does more to hamper travel and research in the Rif than all other factors combined.

VEGETATION

It is too early in the course of Riffian research to give a complete list of botanical species from that country; no systematic botanist, as far as I know, has published any description of its flora. It will therefore have to suffice in this volume to present merely a very fragmentary roster of some of the more noticeable wild trees and bushes, such as readily meet the eye of the traveler, with local names and tentative identifications, made by observation and by analogy with the rest of North Africa.

Conifers

taidha, a tall, straight-growing conifer, with a large globular cone. This tree is much prized for house-building material.

taidha temjda, a similar tree, relatively stunted, with thick, wide branches. The *taidha* is found on the upper slopes of mountains; the *taidha temjda* grows on the mountain-tops and in the passes, where it is exposed to the elements: hence both may belong to the same species. (Plate I shows examples of both.)

Justinard calls the *taidha* a pine.[1] Hanoteau and Letourneau list for Algeria four species of terebinths; *Pistacia terebinthus L.*, *P. Atlantica Desf.*, *P. Lentiscus L.*, and *Rhus pentaphylla Desf.*[2]

takka, another conifer, with a small, compact cone. The wood of this tree is used in making tar. (Perhaps its name is related to the Ntifa word for terebinth.[3]) Justinard calls this a juniper.[4]

afezaz, the scrub juniper (not to be confused with *afesas*). Laoust postulates that the Berber root *zz* indicates the idea of spines or thorns, and cites other words, in Berber dialects, which contain this root and mean juniper.[5]

[1] Commandant Justinard, *Manuel de Berbère Marocain* (*Dialecte Rifain*), p. 48.
[2] A. Hanoteau and A. Letourneau, *La Kabylie*, vol. I, pp. 82–83.
[3] E. Laoust, *Mots et Choses Berbères*, p. 487. [4] Page 131. [5] Page 523.

1: Coon E-5 (1926-1927) 1931 MX3 Rif MX3

riars, a cedar, growing very tall and straight. Its sweet-smelling wood is valued by carpenters and cabinet-makers.

amerzi, another cedar, with very volatile reddish wood. Its pitch and resin are used as medicine.

rkanus, a similar tree, considered by the Riffians to be the female of the *amerzi*.

The cedars, generally known under the name of *thuya*, or *arbor vitæ*, form the characteristic coniferous vegetation of North Africa.[1]

Other Trees

rbejuth, an evergreen oak, with edible acorns.

tashta, another species of oak, with inedible acorns.

rbejuth n yirif, the so-called pig-oak. Its acorns are eaten by wild boars, but not by men on account of their bitter taste. Justinard lists as oak *adren*, calling *abedjoud* the acorn.[2] The latter word is derived from the Arabic *el-bellut*, the difference in renderings being due, aside from different techniques in transcription, to my retention of the *r*, the berberization of the Arabic definite article, in the Riffian dialects. I have always heard it pronounced with the *r*. Hanoteau and Letourneau [3] identify five oaks in Algeria: *Quercus castaneæfolia C. A. Mey., Q. Mirbeckii Dr., Q. Ilex L., Q. Ilex var. Ballota*, and *Q. Suber L.*

adheman, the hawthorne. This tree is used as a base for grafting pear and apple shoots. Hanoteau and Letourneau give *Crataegus Oxyacantha* (three varieties), *Cr. Azarolus*, and *Cr. monogyna* for Algeria.[4] Laoust identifies *Cr. Oxyacantha* in Morocco.[5]

asanú, the arbute, or strawberry tree. Its fruit is eaten fresh, and also dried and put into bread; the wood is used in house construction. Laoust finds it in other parts of Morocco, and gives it the botanical name *Arbutus unedo*.[6]

fathis, a large tree bearing a small red fruit, which is eaten. The ashes of its wood are mixed with water, in which grapes are washed before being set out to dry. These ashes are also used as soap in washing cloth. Westermarck [7] calls this the lentisk, *Pistacia lentiscus*.

azemmur, the wild olive. Its fruit is not eaten, but its wood is used in making spoons, ploughs, and other objects.

thazemmurth, the female of the *azemmur*, smaller than the male. The male can be used for grafting domestic olives, but the female is never used for this purpose.

sa'aris, a large tree with perennial foliage. It bears a seed containing a red liquid. The wood of this tree was formerly used for gunstocks.

thaghieshth n wushun, a species of wild walnut, called jackal-walnut.

afesas, perhaps a spurge-flax, or broom. It is a bush with a red flower, growing in valley bottoms. Laoust gives *Daphne Gnidium L.* for *walesas*.[8] Hanoteau and Letourneau name three species, *Daphne oleoides Schreb., D. Gnidium L.*, and *D. Laureola L.*, for Algeria.[9] This plant has been mistaken by other botanists for an osier, on account of its extensive use in basketry.[10]

thabgha, a wild blackberry. Justinard affirms this designation.[11]

[1] Justinard, p. 180; Hanoteau and Letourneau, p. 60; el Bekri (tr. Macguckin de Slane), p. 15 n.
[2] Page 117. [3] Page 119. [4] Pages 48, 99. [5] Page 509.
[6] Pages 483–484, 519. [7] Edward Westermarck, *Ritual and Belief in Morocco*, vol. II, p. 185.
[8] Pages 515–516. [9] Page 116. [10] Laoust, pp. 515–516. [11] Page 142.

1: Coon E-5 (1926-1927) 1931 MX3 Rif MX3

ariyeri, the oleander. This plant is important in the manufacture of magical concoctions. Laoust [1] and Justinard [2] support this identification.

tuzzelt, a bush resembling a high-bush blueberry. It bears a red pod, like a rose-pod, which is eaten. Laoust [3] calls this *Fraxinus dimorpha*.

aghanim, a reed, used extensively in basket making. Laoust supports this identification.[4]

tharugwith, a bush with a red flower, much frequented by bees.

sus, a bush bearing a white flower, with peppery-tasting leaves. The latter are used as medicine for stomach-ache.

i-knuafer, a bush or low tree which produces a bud resembling a clove. The buds are put into tea as a spice, and are used as a stomach-ache cure for children.

azir, a bush the leaves of which are used in the brewing of a tea alleged to be beneficial in fever.

izarshi, forsythia. Women cut pieces of its stem and tie them in their belts to prevent boils. This identification is purely personal and lacks confirmation.

thakhfa, a wild rose, the pods of which are sometimes eaten in times of famine. Hanoteau and Letourneau [5] give *Rosa sempervirens* for the Kabyle *thaafert*.

Luxurious forests of conifers are said by the inhabitants of the country to have once covered most of the region, but today they are confined to the mountains of Beni Bu Nsar, Taghzuth, Beni Khennus, Beni Seddath, Ktama, Zarket, and the upland reaches of Mtiwa. Patches of this forest remain on Mt. Kuin in Gzennaya, in parts of Beni Amart, at Aswil, where the Nekor passes from the Gzennaya into Beni Urriaghel, and on the crests of Beni Tuzin. The *taidha* grows chiefly in the Senhajan tribes, but the *thuya* is found not only there but also farther to the east, in Gzennaya and Beni Tuzin.

After climbing from the hot barrenness of the eastern Rif, one finds the forests of the Senhaja Sghir most beautiful and satisfying. On the mountain between Beni Bu Nsar and Taghzuth, it is difficult to realise that one is in Morocco. The whole of this section reminds one of temperate forests, such as are found in the Northern United States and Canada; especially is this true in the long, flat plateau-valley of Beni Seddath, where a lush meadow is variegated with frequent clumps of *taidha*. Even in midsummer this region retains an exhilarating chilliness of atmosphere. (See plate 1.)

CLIMATE

The slopes of the Mediterranean border of this region are rugged, mostly deforested, hillsides, with a climate similar to northern Mexico or our own Southwest. Farther to the east, in the tribes of Beni Said, Beni Ulishk, Tafersit, and parts of Galiya, the country becomes rolling and its slope relatively gentle, and grain is grown on it without terracing or irrigation. Farther south, however, stretches the arid expanse of the Garet, that waterless waste whereon the Metalsa and Beni Yahyi shift about from camp to camp. This desert stretches into parts of Beni Said and Galiya, and oversteps the boundary of Beni Ulishk and Tafersit. Here in the Garet grows a sparse crop of grass, and quantities of that coarse grass called *halfa*, resembling our own marsh or beach grass, from which the nomadic peoples, and the Gzennaya and other Riffians as well, make sandals, pack-saddles, ropes, and all sorts

[1] Page 484. [2] Page 135. [3] Pages 493, 490.
[4] Page 453. [5] Page 48.

1: Coon E-5 (1926-1927) 1931 MX3 Rif MX3

241 Riffian acquisition of vegetable food may be divided into four processes, some of which may be developmental stages, and all of which are in contemporaneous use.

1. The gathering of edible wild plants.
2. The care of fruit and nut-bearing trees and of vineyards.
3. The care of gardens.
4. The cultivation of grains and leguminous plants.

The following subjects also pertain to agriculture and vegetable food-getting.

1. A calendric cycle of agricultural events.
2. Tools and machinery.
3. Communism in agriculture.

222 137 **Collecting and Gathering.** There are certain wild products growing on mountains, in valleys, in springs, and on refuse heaps, which are of food value and are collected and eaten, either from choice or as emergency rations in time of famine, although no attempt is made to cultivate them. So far as can be determined, they are as follows.

azemmur,[1] the wild olive.

erbejuth,[1] the oak. Both acorns and the tree upon which they grow are called by the same name.

adheman,[1] the hawthorne. The haws, called *saaror*, are gathered and eaten.

larnej,[2] a wild lemon tree, probably escaped from cultivation.

tuth,[2] the mulberry, at present wild. It was probably introduced earlier and then abandoned.

[245] *habb ul muluk*,[2] the wild cherry, with probably the same history as the mulberry. Both trees are now cultivated by the Senhaja.

sasanu,[1] the arbute, or strawberry-tree. Its fruit is eaten fresh, also dried and put into bread.

thabgha,[1] wild blackberries.

tuzzelt,[1] a bush the pod of which is eaten.

thakhfar,[1] a wild rose, the pod of which is eaten.

askum, wild asparagus.

ma'isha, the wild tomato, found in old refuse heaps. Its cultivation has been abandoned.

thebiseth,[3] a plant growing in the mountains, eaten as a green.

yanush, watercress, or a very similar plant.

thezhiuma, another water plant, growing in springs.

thafa ikshuth, a wild plant resembling celery.

thighigheshth,[4] a wild plant the roots of which are boiled and used for washing wool. Its leaves are cut up, boiled, and eaten.

benaaman, a wild poppy. Women eat its leaves, and children its buds.

imzwar, a plant resembling shamrock or clover. Its leaves, slightly sour in taste, are eaten.

iuasrin, mushrooms.

[1] See Introduction, p. 8.

[2] The wild lemon, cherry, and mulberry were not mentioned in the Introduction because they are not indigenous.

[3] This is perhaps related to the root given by Laoust (p. 506) for mallow. *Tibidas*, in the Zemmour dialect, is the cloare.

[4] Laoust (p. 39) suggests that this may be *Saponaria rucaria*.

3: Hart E-5 (1953-1954)1954 MX3 Rif MX3

101 their archaic Berber cultural patterns in the face of an ever-increasing Arabization. For this reason, I use the Berber term *Aith* (sons of) rather than its Arabic equivalent *Banī*, which has become current in the literature. Although a tribesman who does know Arabic will say *Banī* when speaking of his tribe to a stranger, he will employ *Aith* when in conversation with his own people. I have also singled out the tribe of Aith Wuryāghil as the object of this article not only because, at the time of writing, I know it much better than the other Riffian tribes, but because, as it is the largest and most powerful of all of them, it has always taken the leading role in the past history of the Rīf, and it has, on most occasions, called the turn to the other tribes when necessary. The presence of Aith Wuryāghil, with that of Gizināya, in the confederation of the Ṣinhāja during the great Ṣinhāja-Ghumāra war was what won that war for the former group; and in recent times the tribe produced 'Abd al-Karīm, of whom we shall say more later on.

133 Running in a northeast-southwest direction, the tribal territory, 1028.5 square kilometers, consists, in the north, of an open alluvial plain bordered on the east by the mountains of Tamsamān; this plain overlooks the Mediterranean and forms the Bay of Alhucemas. Further south it gradually ascends into and merges with the brown, barren and eroded mountains which are such a characteristic feature of the Riffian landscape; these are bisected by arroyos and high valleys, and in Aith Wuryāghil they culminate in the rugged massif of Jabal Ḥammām (1948 meters), which is covered with snow in [137] January and February. Vegetation consists largely of scrub and 132 lentiscus bushes. Except in the highest altitudes, rain is infrequent even in the winter; the so-called «levante», coming from Spain, brings it suddenly and in the form of flash floods, which change the two sluggish rivers in the tribal territory, the Ghīs to the west and the Nakūr to the east, into raging, torrents. In the mountains the winters, although not long, are cold, but snowfall is much less than in Aith 'Ammarth or in the Ṣinhāja Srair to the southwest, where the mountains are considerably higher. The rest of the year the climate is warm and usually so dry as to produce only a bare subsistence economy.

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3

Drainage

132 133 Drainage basins are small in this area, for the watershed is close to the sea. The seasonal rate of flow follows the seasonal rainfall, but with a lag in time that varies with the slope, the vegetation, and the permeability of the rock. Spate follows rainfall where impermeable rocks form the basin, more slowly where the basin is of permeable limestone. All the Mediterranean streams may be roaring torrents at some period from October to May; but most of them dry up during the long summer drought. The valleys of some of the larger streams, like the Ghis and Nkour, betray their Mediterranean regimen by a double bed: in summer a narrow channel is cut below the broad rocky shelf which is the winter bed. Wad Ouergha draws off most of the drainage from the Sanhajan highlands; it is the largest stream flowing from the Rif chain, and one of the sources of irrigation water in the Gharb coastal plain (fig. 1). The basin of Wad Lukkus includes most of the Atlantic drainage. Surface streams are rare in the calcareous zone. The only stream that flows through the limestone mountains is the Wad Lao, which follows an antecedent course; but Wad Hajara, Wad Khemis, and Río Martín (Wad Martil) are fed by springs issuing from the base of this range. The area between Wad Nkour and Wad Moulouya has only one large stream, Wad Kert, and it receives little nourishment after it leaves the highlands. Wad Moulouya, from the distant Ayache Mountains of the High Atlas, is northern Morocco's great exotic stream. This stream and Wad Lukkus constituted the only natural segments of the boundary between French Morocco and Spanish Morocco.

Plant Domains

137 The vegetation of North Africa can be divided into (1) a Mediterranean domain, where forest and shrubs predominate; (2) a domain of "steppe," where forest is confined to highland enclaves in the midst of a predominant cover of grass and herbs; and (3) a domain of highland vegetation, which includes a subalpine formation with some trees and, only in the Moroccan Atlas, an alpine formation [132] without trees. Saharan vegetation penetrates Barbary at only two points: in the Hodna basin of Algeria and on the plains extending inland from the Gulf of Gabès in Tunisia. Figuig, Ksar as-Suq, Zagora, and Goulimine, all within the political limits of Morocco, receive less than 200 mm. of precipitation per year, but the records of these stations do not show the variability indicative of true desert. The Moroccan territory south of the Atlas chains forms part of the "pre-Sahara" of French terminology.[1]

In terms of this classification, all but a small part of northern Morocco falls within the Mediterranean domain. No peak in the Rif Mountains rises above timberline, and only a small area can be called subalpine. Grassland is confined to one area on the eastern edge of the zone. This area, in the lower Moulouya Valley, is one of the driest parts of northern Morocco, but it is not certain that the presence of steppe vegetation can be attributed solely to meager precipitation. The dominant species is *Stipa tenacissima* (Arabic *alfa*). This hard tussock grass

[1] For a brief description of vegetation in all North Africa, see Jean Despois, *L'Afrique du Nord* (Paris: Presses Universitaires de France, 1949), pp. 80–96; and Louis Emberger, "L'Afrique du Nord-Ouest," *Unesco Arid Zone Research*, VI, "Plant Ecology" (Reviews of Research) (Paris, 1955), pp. 219–249.

[113]

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3

has deep roots, forms strong clumps, and its awns stick to the coats of passing animals. More important, it is palatable only for a brief period in spring.[9] Alfa grass is scattered over most of Garet, but is conspicuous only in the area between the hills of Ikbdhanen and Kar-Kar.

Forest, Maqui, Garrigue

The climate that has prevailed during historic time is such that trees ought to dominate the vegetation of this zone. As figure 7 indicates, *Pistacia atlantica*,

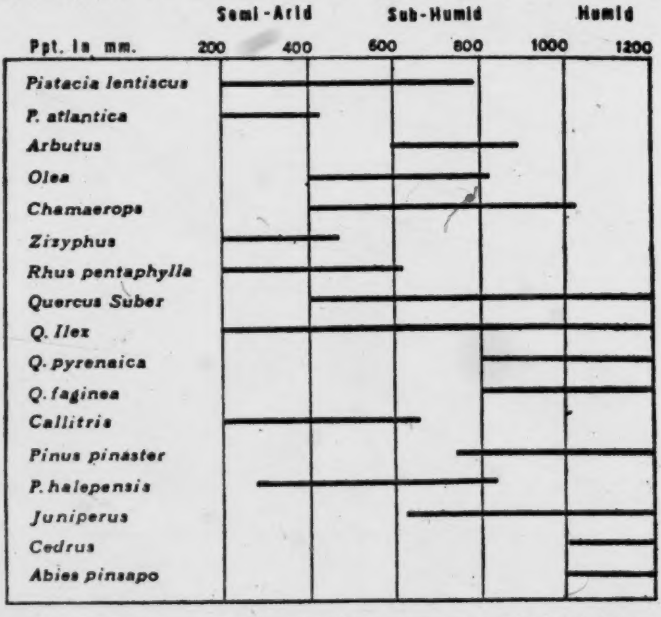

Fig. 7. Range of forest species according to average annual precipitation.

P. lentiscus, Quercus Ilex, Pinus halepensis, Callitris articulata, Rhus pentaphylla, and *Zizyphus lotus* can grow in the semiarid sector of northeastern Morocco. The altitudinal range of at least three and possibly eight trees extends above the highest peaks of the Rif chain (table 1). Edaphic factors impose some limitations. The cork oak will not grow on calcareous soils, and most forest species are excluded from poorly drained alluvium. Nevertheless, areas that are barren of trees as a result of natural causes constitute only a small part of this zone.

Most of the forest species common in northern Morocco are endemic to the Mediterranean region; a few belong more specifically to the western province of that region. *Quercus coccifera, Quercus Ilex, Pinus halepensis, Arbutus Unedo,* and a number of prominent Moroccan shrubs are spontaneous in most of the

[9] Charles Killian, "Plantes fourragères-types des hautes-plaines algériennes," *Annales de l'Amélioration des Plantes,* 4 (1954), 505–527.

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3

137 Mediterranean lands. The natural range of *Pinus pinaster, Chamaerops humilis,* and *Quercus Suber* extends to Sicily and the western versant of Italy, but not to Greece, Turkey, or Lebanon.[9] As typical elements of Mediterranean vegetation, these plants are provided with mechanisms of defense against excessive transpiration during the long summer drought. The trunks of most trees are incased in a thick, deeply fissured bark; leaves are thick and leathery, and have hard, shiny surfaces. Under normal conditions few of the Moroccan trees cast deep shade; so the understory is usually well developed.

This shrubby undergrowth of bushes and small trees may form a dense thicket,

TABLE 1

ALTITUDINAL LIMITS OF SOME MOROCCAN TREES

Species	Elevation (meters)	Location
Rhus pentaphylla	1,000?	Rif?
Zizyphus lotus	1,000?	Middle Atlas?
Pistacia lentiscus	1,600	High Atlas
Olea europaea	1,650	High Atlas
Callitris articulata	1,800	High Atlas
Arbutus Unedo	1,900	Anti Atlas
Pistacia atlantica	2,000	High Atlas
Quercus Suber	2,000	Rif
Quercus pyrenaica	2,000	Rif
Quercus faginea	2,200	Middle Atlas
Chamaerops humilis	2,200	High Atlas
Pinus halepensis	2,200	High Atlas
Pinus pinaster	2,200	Rif
Abies pinsapo	2,200	Rif
Cedrus atlantica	2,700	High Atlas
Quercus Ilex	2,800	High Atlas
Juniperus Oxycedrus	3,150	High Atlas

SOURCE: Personal observations and Louis Emberger, *Les Arbres du Maroc et comment les reconnaître* (Paris: Larose, 1938).

but is more often degraded by burning, cutting, or browsing. There are many names for it: in Greek *longos,* in Spanish *monte bajo* or *matorral,* in Italian *macchia,* while we have adopted the Corsican—and French—*maqui(s).* It is a mixed association of evergreen plants, with tough and twisted wood, brilliant and often scented flowers, and shiny or glaucous foliage. Where degradation has been severe, the maqui ceases to form a closed canopy. This type of rather stunted and open vegetation, known in France as *garrigue*—from *garoulia,* the Provençal name for *Quercus coccifera*—is marked by a wealth of aromatic Labiatae, Cistaceae, and Rutaceae, which sprout and germinate quickly after fires. All these plants, whether maqui or garrigue, are heliophilous and many of them are thorny. In chapter vii it will be demonstrated that garrigue constitutes a degraded form of maqui, and maqui a degraded type of forest.

[113] [9] M. Rikli, *Das Pflanzenkleid der Mittelmeerländer* (Bern: Hans Huber, 1943–1948), traces the natural range of most of the plants considered here. See also the "Notice explicative" accompanying Planche 19 a, "Forêts et ressources végétales," *Atlas du Maroc,* cited in note 7.

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3

Relict Species

137 The vegetation of northern Morocco has not only been modified by man, but has also undergone progressive natural change. In the varied Moroccan flora, European, Asiatic, and tropical elements are found along with species endemic to the Mediterranean region. During the Pleistocene, the southward movement of a colder and wetter climate brought corresponding southward migrations of European and Euro-Siberian plants. Europe and Barbary were no longer linked by land bridges, but seeds could easily blow or float across the narrow Strait of Gibraltar. Relicts of these invasions are found today in the mountains of northern Morocco in growths of fir (*Abies pinsapo, A. tazaotana*) and deciduous oaks (*Quercus pyrenaica, Q. faginea*) that seem strangely out of place in northern Africa.[11] Other Pleistocene relicts include birch (*Betula alba*), two species of maple (*Acer monspessulanum, A. Opalus*), alder (*Alnus glutinosa*), and the mountain ash, or service tree (*Sorbus torminalis*).[12]

Enigma of the Oleaster

The olive tree (*Olea europaea*) has long been regarded as a symbol of the Mediterranean landscape. Since classical antiquity it has been recognized that not all olive trees are alike, that some grow without cultivation and produce small and bitter fruit. The "wild" olive, or oleaster, was long thought to be an endemic element of the Mediterranean flora and the ancestor of the cultivated tree. Victor [114] Hehn may have been the first to challenge this view on historical and philological grounds.[13] Today this problem is the subject of vigorous debate. Most authorities consider the oleaster to be a natural element of maqui, but some scholars, including August Chevalier, describe it as a "subspontaneous race," escaped from cultivation in ancient time.[14]

[245] In contrast to the common cultivated olive, the oleaster has four-angled thorny branches, broader leaves, and smaller fruit. Moreover, the oleaster, obviously, grows without cultivation or apparent care. None of these points proves that it is an ancestral wild race. As De Candolle remarks, "In a woody species which lives so long and shoots again from the same stock when cut off by accident, it is impossible to know the origin of the individuals observed."[15] To make matters worse, [245] it is a common practice in northern Morocco to graft scions of the cultivated olive to oleaster stock.[16]

The oleaster is best developed in the area covered by palmetto scrub, where the winters are too cold and wet for the cultivated race, but a few oleasters are seen

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[11] Changes of climate also have been invoked to explain the presence of wild olive (*Olea Laperrini*) and cypress (*Cupressus Dupresiana*) in the mountains of the central Sahara. L. Lavauden, "Les Forêts du Sahara," *Rev. des Eaux et Forêts*, 65 (1927), 265–277. 113 137

[12] The adaptation of "Nordic" species to the Mediterranean environment is considered by Andrea Giacobbe in "Les effets écologiques de l'aridité du climat sur la végétation méditerranéenne: héliophilie et configuration morphologique des forêts," *Unesco Arid Zone Research*, V, "Plant Ecology" (Proceedings of the Montpellier Symposium) (Paris, 1955), pp. 64–66.

[13] Victor Hehn, *The Wanderings of Plants and Animals from Their First Home* (London: Swan Sonnenschein, 1888), pp. 88–101.

[14] Aug. Chevalier, "L'origine de l'olivier cultivé et ses variations," *Revue de Botanique Appliquée et d'Agriculture Tropicale*, 28 (1948), 1–25.

[15] Alphonse de Candolle, *Origin of Cultivated Plants* (New York: Appleton, 1885), p. 280.

[16] Pliny (*Natural History*, XVII, 30) thought that this practice was limited to Africa.

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3

in the semiarid region south of Melilla. Both varieties sprout vigorously, and both are polymorphic. The latter fact is of major significance, for if the oleaster were a wild species it should be monomorphic, at least in a given area. Chevalier's argument is based upon this point. The seemingly primitive oleasters may be escaped and neglected variants of races that were once cultivated." The longevity of the olive is lengendary; some sprouts in Algeria and Tunisia are almost certainly derived from Roman trees." The fact that some trees have spines and small fruit may not be distinctive. Both varieties probably evolved from *Olea chrysophylla*, the true wild olive of southwestern Asia." The oleaster may be no more difficult to explain than the "wild" pears and apples in the forests of France. It is not unusual for a neglected cultivated plant to become naturalized. Subspontaneous varieties of the cultivated carob tree (*Ceratonia siliqua*) are common in the Mediterranean region. In northern Morocco this tree, cultivated for its edible pods, is widely scattered in the area covered by palmetto scrub. Like the oleaster, it often appears to be a natural element of the maqui.

Shrub Formations

In most of the Mediterranean basin, shrub formations now cover much more territory than do forests (fig. 8). In northern Morocco, shrub vegetation is dominated by dwarf palm or palmetto (*Chamaerops humilis*) and the xerophytic camel thorn (*Zizyphus lotus*). The range of these two species delimits two shrub formations, palmetto scrub and thorn scrub. The first formation is the *Oleo-Lentiscetum* (i.e., *Olea europaea—Pistacia lentiscus*) of most authors, but in northern Morocco neither of these plants is as conspicuous as the palmetto.

The palmetto (Arabic *doum*) is best developed on argillaceous soils in areas of mild temperature and moderate to heavy precipitation (fig. 7). These preferences explain the absence of palmetto in the cool highlands and its rare occurrence in semiarid areas. Dwarf palm may be seen on rocky knolls near Wad Moulouya, but most of the eastern half of northern Morocco is too dry for the species. In the western half of the zone the altitudinal limits of palmetto rise from west to east according to the lessening amount of precipitation.

The popular names "dwarf palm" and "palmetto" as well as the Linnaean binomial (*Chamaerops humilis*), derived from Greek and Latin roots meaning "dwarf or stunted bush," do not suggest that this plant may grow five to ten meters high. Excellent specimens of this height are preserved, however, at the cemeteries of Chella near Rabat and at Asni south of Marrakech. In northern Morocco I have seen tall palmettos on several sacred sites. Palmetto is exploited

[TEXT CONTINUED ON PAGE 25]

[9] H. Camps-Fabrer, *L'Olivier et l'huile dans l'Afrique romaine* (Algiers: Service des Antiquités, 1953), p. 11, states that charcoal from a midden near Tébessa in eastern Algeria "a révélé d'une manière certaine l'existence de l'oléastre en Afrique au Paléolithique Supérieur." But in the study to which she refers—R. le Du and L. Saccardy, "Etude de quelques charbons préhistoriques de la région de Tébessa," *Rev. Africaine*, 88 (1949), 111–119—there is no mention of oleaster. Charcoal of *Phillyrea*, another genus of the olive family, is mentioned, but this adds nothing to the history of *Olea europaea*.

[10] L. Joleaud, "L'ancienneté de la fabrication de l'huile en Afrique du Nord," *Rev. Africaine*, 70 (1929), 19–36.

[11] If this be correct, the present range of the cultivated olive is almost completely separated from that of its ancestor. I. H. Burkill, "Habits of Man and the Origins of the Cultivated Plants of the Old World," *Proc. Linnean Soc. London*, 164 (1951–1952), 12–42, ref. to fig. 2, p. 16.

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3 ●
Jebala MX2
Senhaja MX4
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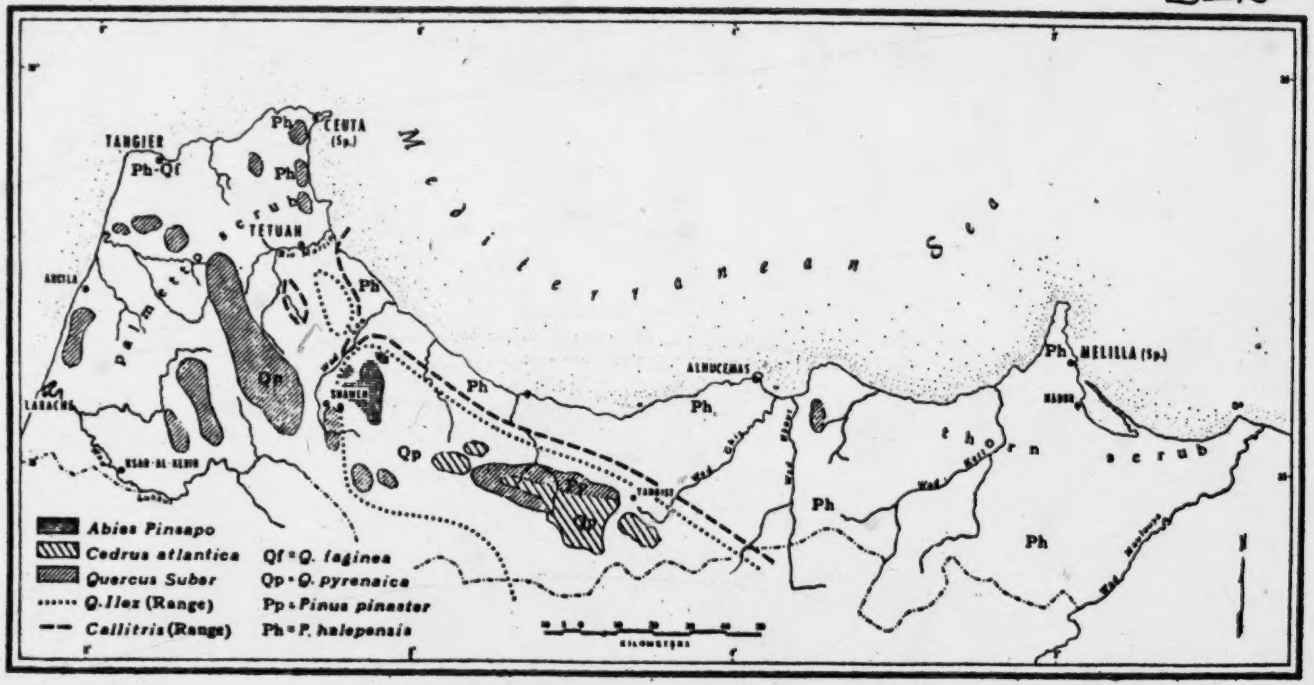

Fig. 8. Northern Morocco: distribution of forest and scrub.

/p. 241

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3

Palmetto is exploited for its edible bud, and the old women who sell *ghaz* (palm cabbage) are a common sight in the streets of Tetuán and Tangier. During the summer, when cereal stocks are low, many families spend some time digging up palmetto.

Palmetto is exploited also for its fiber, used in the manufacture of *crin végétal*. The collecting is done by women, who deposit bundles of palm blades near scales set out along most of the roads. The fiber is dried in the sun, and then twisted into loose rope and baled for marketing. The finished product serves as a substitute for horsehair in upholstering. In 1955, exporters in the northern zone handled 12,622 tons of fiber.[20] Native craftsmen make hats, mats, and baskets of the same material.

Disturbance of this sort encourages lateral development rather than tall growth from a single stock, but seldom results in destruction of the plant.[21] The resiliency of palmetto is attested by its persistence in cultivated fields. The native farmer has no means of eradicating the deep roots of this plant. Fields are burned and then cleared with hoes and cutting tools. This practice eliminates most shrubs, but it does not destroy palmetto. On the contrary, this plant, as a deep-rooting and heliophilous species, profits from the removal of competitive growth. When fields lie fallow or are abandoned, dwarf palm promptly begins to colonize.[22] In relatively undisturbed formations the palmetto is of secondary importance. It is not conspicuous, for example, in mature stands of cork oak. On sacred sites palmetto is usually found on the edges of the protected growth. Where shrub vegetation is especially dense, as it is along the Mediterranean coast from Wad Lao to Puerto Capaz, dwarf palm grows on sunny south-facing slopes and on the upper edges of stream channels. Pure stands of palmetto seem to indicate floristic and morphologic impoverishment, a reduction of vegetation to its most resistant element.

Pistacia lentiscus (Arabic *dro*) is the second most important element of palmetto scrub. As with dwarf palm, it may be doubted that this plant should be described as a shrub. *Dro* usually appears as a shrub about one meter high, but where soils are deep and plants protected, it may grow three to five meters high. Such trees are rare today. With the exception of a few specimens scattered in the Anjra hills northeast of Tetuán, I have seen tall pistacias only on sacred sites and in a few areas protected by fences. In one form or the other this plant is encountered as an element of maqui in most of the Mediterranean region. It is found almost everywhere in Morocco; only in areas of extreme aridity and in the mountains above 1,500 meters is it absent. *Dro* is mixed with *Zizyphus lotus* in the Nkour

[20] *Marruecos, zona jalifana: guía económica* (Tetuán: Delegación de Economía, 1955), p. 59.

[21] The ability of the palmetto to survive disturbance is recognized by Theophrastus (*Enquiry into Plants* . . . , II, 6): "The dwarf-palm is a distinct kind, having nothing but its name in common with the other palms. For if its head is removed, it survives, and, if it is cut down, it shoots again from the roots." Louis Emberger concludes, in *Les Arbres du Maroc et comment les reconnaître* (Paris: Larose, 1938), p. 76: "Cette forme naine est determinée par l'action continuelle des troupeaux, qui broutent les jeunes pousses, et de l'homme qui exploite le Palmier nain pour en faire des cordages et consummer le cœur." M. Rikli, "Marokko," *Vegetationsbilder*, 24, Heft 4/5 (1934), concurs in this judgment, and adds that the prevalent form of the palmetto "als fuss- bis kniehohes Hartlaubgestrüpp ist sekundär, durch anthro- und zoogene Einwirkung entstanden."

[22] According to Louis Emberger, *Aperçu général sur la végétation du Maroc* (Bern: Hans Huber, 1939), p. 150, "son expansion est le résultat de la destruction des forêts dans lesquelles il était un élément floristique constant." G. Kuhnholtz-Lordat, *La Terre incendiée: essai d'agronomie comparée* (Nimes: Editions de la Maison Carrée, 1939), p. 44, coins a new verb, *endoumer*, the process by which forests degenerate to thickets of *doum*.

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3

delta, but it becomes progressively rarer toward the eastern semiarid sector of this zone. Pistacia wood is highly prized as a source of charcoal, and this fact alone may explain the plant's degraded appearance in the hills south of Tangier.

Pistacia rarely forms a pure stand. Several of the other plants found in palmetto scrub could be described as weeds, for they appear mainly in fallow fields. *Asphodelus microcarpus, Urginea maritima, Daphne Gnidium,* and one or more species of *Asparagus, Ononis,* and *Papaver* are prominent among them. In areas where most of the surface is cultivated, as in the Fahs territory south of Tangier, these plants, together with thistles and scattered clumps of palmetto, constitute all but a small part of the total inventory of vegetation. On rocky knolls and alluvial slopes too steep for cultivation, these plants grow among *Pistacia, Calycotome, Lavandula,* and the oleaster. The percentage of thorny plants is high. Besides *Calycotome* and thistles, *Carduus, Smilax,* and *Rosa* are found.

Dense shrub formations are rarely seen on the thickly settled Atlantic versant. One may walk unimpeded anywhere in the zone bounded by the Atlantic coast, Tangier, and Ksar al-Kebir. The thick shrub growth on the Mediterranean coast near Wad Lao contrasts sharply with the open formations on the Atlantic littoral. In the former area, *Cistus ladaniferus, C. albidus, Erica arborea, Pistacia lentiscus,* and *Arbutus Unedo* combine to form an impenetrable thicket. The limestone mountains of northern Morocco are almost bare of shrub or tree growth. From Ceuta to Wad Lao the eastern horizon is dominated by a great wall of limestone, almost completely devoid of soil. The prevalent whiteness is disturbed only by scattered clumps of palmetto and spiny gorse (*Ulex parviflorus*).

In the area covered by palmetto scrub the persistent riparian plant is the toxic *Nerium oleander*. It may be accompanied by *Crataegus, Myrtus,* and *Arbutus,* but in most of northwestern Morocco the oleander is the only plant on the banks of streams. The presence of *Alnus, Populus, Salix,* and *Vitex* along stream channels in the Sanhajan highlands may be explained by the persistence in that area of other trees, especially cedar, juniper, and oak, which have been adequate thus far as a source of fuel and building material.

In the drier eastern sector of northern Morocco, palmetto scrub grades into a thorn scrub dominated by *Zizyphus lotus,* a spiny and xerophytic member of the buckthorn family (Rhamnaceae). It is difficult to draw a line between these two formations. Isolated clumps of palmetto are found as far east as the Moulouya Valley, and zizyphus extends up the valley of Wad Ghis as far as Targist.

Well adapted to aridity and continentality, *Zizyphus lotus* has become the dominant plant of Morocco's semiarid plains. Clumps of zizyphus are conspicuous within most of the area mapped as thorn scrub. This plant may grow three meters high, but is most often seen as a shrub. It is deciduous; and, during the dormant winter season, gray and seemingly lifeless clumps of zizyphus are a characteristic feature of the landscape. Its branches are widely used as fence material, and this practice enhances the contrast between the semiarid sector of northern Morocco and the wetter western zone, where *Opuntia* is planted as a hedge. The fleshy drupe of zizyphus is collected wherever it grows; when cereal stocks are exhausted, "lotus bread" is an important food."

" *Zizyphus lotus* is occasionally planted in Andalusia, Portugal, and Sicily, but in northern Africa the fruit is collected from wild plants. Aug. Chevalier, "Les jujubiers ou zizyphus de

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3

137 On protected sites, zizyphus and sumac (*Rhus pentaphylla*) form a thicket. In areas where zizyphus and sumac are mixed with *Pistacia atlantica*, the thorn scrub formation could be described as a thorn forest. Fields that have been fallow for several years are covered with *Asphodelus microcarpus*, *Marrubium alysson*, *Fagonia cretica*, and *Lycium intricatum* as well as the ubiquitous zizyphus. Alfa grass (*Stipa tenacissima*) covers part of the area between Ikibdhanen and Kar-Kar. Alluvial soils in the same general area are covered with esparto grass (*Lygeum spartum*) and dwarf sage (*Artemisia herba alba*). The areas occupied by these three species may be advanced colonies of the steppe formations of the upper Moulouya Valley and the Algerian Hauts-Plateaux.

Forest Formations

As figure 8 indicates, most of the forest species in northern Morocco belong to the families Pinaceae and Fagaceae. Two evergreen oaks dominate the latter group: the holly or holm oak (*Quercus Ilex*) and the cork oak (*Quercus Suber*). The wide range of the holly oak is indicative of its edaphic and climatic tolerance (fig. 7). In northern Morocco it is found from an elevation of about 500 meters up to the crest of the Rif chain. It is mixed with cedar and fir above 1,500 meters and with zizyphus in the semiarid region east of Alhucemas. *Quercus Ilex* may appear as a tall tree, but most specimens show the damaging effects of fire, cutting, and browsing. The holly oak is certainly a forest species, but it would be misleading to speak of forests of this tree. The area delimited in figure 8 merely indicates the zone in which specimens of this species are numerous. Many specimens are only two meters high. Emberger estimates that *Quercus Ilex* is spread over 700,000 hectares of Morocco, and that this territory may represent less than half of the primordial range."

[132] The effective limit of the cork oak nearly coincides with the 400 mm. isohyet. *Quercus Suber* appears on schist in the highlands of Ghmara and Sanhaja, on sandstone in the mountains west of Tetuán and Shawen, and on Pliocene dunes south of Larache. Cork forests are not found on residual soils weathered from limestone, or on heavy alluvial soils. Most of the eastern half of northern Morocco is too dry for the cork oak. A single stand occurs in the highlands east of Wad [132] Nkour, where the orographic mechanism produces rainfall heavier than is observed in the neighboring lowlands.

The natural form of the cork oak is that of a large tree with a short trunk and spreading crown. Specimens of this form are rare today. Tall trees develop from seed regeneration, whereas most trees have a lateral growth that results from sprouting. The latter habit indicates a history of abuse, whether by cutting, burning, or browsing. Undisturbed forests usually have a shaded floor with little underbrush, but cork trees are more commonly accompanied by a number of shrubs. The faithful companion of *Quercus Suber* in northern Morocco is the woody briar *Erica arborea*, which also avoids calcareous soils. Under conditions of extreme degradation, the quick-seeding Cistaceae and the aggressive palmetto are more prominent than other undergrowth. Frequent disturbance, especially

[222] [113] l'ancien monde et l'utilisation de leurs fruits," *Revue de Botanique Appliquée et d'Agriculture Tropicale*, 27 (1947), 470–482.

" Emberger, *Les Arbres du Maroc*, p. 117.

A, B, [See pp. 24 & 20 respectively--Analyst]

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3

by burning, may completely destroy the oaks. The Mamora cork forest north of Rabat (137,000 hectares) is the largest in the world.[11] Cork oak covers about 100,000 hectares in the northern zone.[12]

Much of the economic activity in northern Morocco is concerned with the collection and shipment of cork. The bark of the trunk and the larger branches is utilized. Cork is first removed when trees are about twenty years old, with subsequent stripping every seven to ten years. The first yield (*liège mâle*) is very rough and coarse and of little value. Cork of subsequent stripping (*liège de reproduction*) is more homogeneous and of higher commercial value. In northern Morocco, cork is collected by Spanish concerns with native labor, and also by small independent operators who collect cork from isolated villages and carry it to places of deposit on the main roads. Most of the cork from northern Morocco is shipped in bulk to Spain.

Deciduous oaks cover about 7,000 hectares in northern Morocco. Two species are represented, and they have the scattered distribution characteristic of relicts. The larger stand of deciduous oaks grows at an elevation of about 1,000 meters in the mountains west of Shawen and southwest of Bab Taza—Jbil Buhashim, Jbil Sugna, and Jbil Hazana. *Quercus pyrenaica* = *Q. Tozae* is the species in this area; it appears also at elevations of 1,200–2,000 meters on Jbil Tiziran and, as the binomial indicates, in the Pyrenees. The second species, *Q. faginea* = *Q. lusitanica*, is scattered over the Sanhajan highlands. The largest stands are on the slopes between Jbil Tiziran and Jbil Leshab. Other stands appear on the slopes of Adrar Tidighin and Adrar Taghzut, and there are a few trees mixed with *Erica arborea*, *Cistus ladaniferus*, and *Pistacia lentiscus* in the maqui near Tangier.

It is difficult to explain the scattered distribution of the deciduous oaks. They are abundant in the largest forested area (fig. 8), that of the mountains west of Shawen, but many of the trees in this forest were cut by the Spanish for use as railroad ties. Both species seem to be calcifuge, and it is unlikely that either will be found in the drier parts of the zone. The scattered and mountainous distribution suggests that the deciduous oaks are Pleistocene relicts now restricted to the coolest and wettest parts of northern Morocco. The extreme polymorphism of *Quercus faginea*, with its great number of subspecies and races, seems to support this view.

The highest peaks in northern Morocco are clothed with forests of fir and cedar. The former genus is confined to the calcareous mountains east of Shawen. Two species are present: *Abies tazaotana* occurs at elevations of 1,500–1,854 meters on Jbil Tazaot, and *A. pinsapo* appears on Jbil Maggo, Jbil Tisuka, and Jbil Leshab, as well as in the mountains near Ronda in southern Spain. This restricted highland distribution again suggests that these species are relicts. On Jbil Tisuka and Jbil Leshab, forests of fir begin at an elevation of 1,600

[11] Estimate of Emberger, *Aperçu général sur la végétation du Maroc*, p. 101. For an excellent description of the Mamora forest see A. Métro and Ch. Sauvage, *Flore des végétaux ligneux de la Mamora* (Rabat: Société des Sciences Naturelles et Physiques du Maroc, 1955).

[12] This figure and the estimates of forested surface in later paragraphs are taken from S. Sánchez Cózar, "Montes," *Conferencias desarrolladas en la Academia de Interventores durante el curso de 1947* (Tetuán: Imprenta del Majzen, 1948), pp. 5–25. Earlier estimates appear in E. González Vázquez, *El Marruecos forestal* (Madrid: Ediciones Técnicas, 1945).

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3

137 meters and persist up to the summits at slightly above 2,000 meters. Fir forests are never pure. Deciduous oaks replace fir in moist canyons, and the maritime pine is found on drier, south-facing slopes. Cedar is scattered through most stands of fir, but is conspicuous only on the highest peaks. There are about 6,000 hectares of fir forest in northern Morocco.

The Atlas cedar (*Cedrus atlantica*) is North Africa's most valuable source of timber.[*] Cedar forests are found in the Rif and the Middle and High Atlas in Morocco, and on some of the highest peaks in Algeria. In northern Morocco cedar forests extend from the calcareous range east of Shawen to the schistose mountains south of Targist. A single isolated stand appears on Jbil Kelti, in the karstic mountains of Bani Hassan. The best forests are found on siliceous soils in the Sanhajan mountains, where the cedar is prominent from an altitude of 1,600 meters to the summits of the highest peaks (pl. 1, *b;* pl. 10, *a*). In the valley of Wad Ouergha some cedars may be seen as low as 1,000 meters, and a small stand of very large trees appears at Tlata Ktama at 1,300 meters. In the High Atlas, cedar forests give way to *Juniperus thurifera* at about 3,700 meters. There is no natural timberline in northern Morocco, but trees are stunted on the highest peaks (pl. 1, *b*). Distortion caused by strong winds is especially evident on the summit of Adrar Tidighin. Stumps a meter in diameter have about a hundred rings, but it is difficult to generalize about the age and size of trees, for edaphic and microclimatic factors are highly varied in mountainous terrain.

In the few areas where cedar forests are undisturbed, closely spaced trees shade out shrubs, and undergrowth consists mainly of ferns (*Pteris apulina*). On steep slopes and on the edge of clearings, cedars are mixed with *Juniperus Oxycedrus* and cork oak or holly oak. When cedar forests are cut or burned, the oaks become dominant. When the latter also are destroyed, forest degenerates to scrub. Badly degraded slopes are covered with scrub oaks (i.e., sprouts from the damaged trunks of holly oak or cork oak), *Genista quadriflora, Cistus laurifolius, Halimium lasiocalycinum, Cytisus megalanthus, Daphne Gnidium,* and *Thymus riatarum.* Where destruction of the forest is accompanied by severe erosion, slopes may be covered only by widely spaced clusters of *Genista* and occasional junipers. In areas of sparse human population, stream channels are lined with *Alnus glutinosa, Salix purpurea, Populus nigra, Crataegus laciniata, Rosa canina, Betula alba,* and *Vitex Agnus-castus.*

The distribution of the Moroccan pines is difficult to explain. Two species are identified in figure 8. The maritime pine (*Pinus pinaster*) is scattered in the Rif highlands from Shawen to the Nkour Valley, and the Aleppo pine (*P. halepensis*) appears in the foothills of the Rif chain and at several places on the Mediterranean coast. There are a few stands of maritime pine in the Sanhajan highlands, all on the Mediterranean versant and all at an elevation of about 1,500

[*] Taxonomists usually distinguish four species of *Cedrus:* the Atlas cedar (*C. atlantica*), the Cyprus cedar (*C. brevifolia*), the cedar of Lebanon and southwestern Turkey (*C. Libani*), and the Himalayan deodar (*C. deodara*). Actually, the distinction among these forms is trivial, and some authors prefer to regard them as geographical variants of a single species. René Marie, in his monumental *Flore de l'Afrique du Nord* (Paris: Lechevalier, 1952), lists the Atlas cedar as *Cedrus libanotica ssp. atlantica.* The best general description of the ecology of the several "species" is Louis Emberger's "Contribution à la connaissance des Cèdres," *Revue de Botanique Appliquée et d'Agriculture Tropicale,* 18 (1938), 77–92.

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7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3

137 meters. Near Izagan the maritime pine appears to have colonized areas previously occupied by the cedar.

On the lower slopes of Jbil Leshab a dense cluster of Aleppo pine has been preserved on the site of a cemetery. In this area it is probable that *Pinus halepensis* once occupied an intermediate position, above forests of cork oak but below the zone occupied by cedar and fir. Another small stand of Aleppo pine, consisting of a few hundred trees, is visible from the Tetuán-Shawen route, a few kilometers north of Arba Bani Hassan. A few pines appear on the dunes between Rincón and Ceuta, and there is a small population on the Ceuta promontory. Aleppo pines appear also at Cape Malabata, opposite Tangier, and a few are scattered in the foothills between Wad Lao and Puerto Capaz. In the drier sector of northern Morocco the Aleppo pine is found on the Melilla peninsula and in the hills between the Moulouya Valley and Wad Nkour.

This distribution would be a severe challenge to the most imaginative plant geographer. In the areas in which the Aleppo pine grows, precipitation varies from 1,000 mm. to less than 400 mm. The Aleppo pine appears on Recent dunes south of Ceuta, and on consolidated Pliocene dunes north of Melilla. It grows on sandstone in the Tangier area, and on gneiss at the Ceuta promontory. The scattered pines between Wad Lao and Puerto Capaz grow on a variety of soils, weathered from schist and metasediments. Other trees appear on calcareous soils, and an excellent plantation has been established near Nador on andesite and basalt. It may be necessary to describe the Aleppo pine as a relict now in process of expanding. This explanation is tenable. Relict populations may become centers of dispersal if competitive vegetation is destroyed.[*] Fire, browsing, and other processes that discourage oaks and cedar favor the Aleppo pine, which is remarkably xerophytic and will thrive on thin mineral soils.[*]

The Barbary thuya, or sandarac tree (*Callitris articulata* = *Tetraclinis articulata*), is even more xerophytic than the Aleppo pine, but is less tolerant of cold. Apart from a few specimens on Malta, and in Cyrenaica and southern Spain, the thuya is restricted to northwestern Africa.[*] Thuya formations appear in the highlands of Tunisia and over a large part of Oran province in Algeria; but Morocco is the principal domain of this tree. On protected sites, thuyas may grow to a height of ten meters, but in most of the area outlined in figure 8 they are shrubs. In the northern zone their range can be delimited by the 1,000-meter contour and the 400 mm. isohyet. This concentration indicates a preference for mild temperatures and semiaridity. The presence of thuyas in more humid areas is explained by calcareous soils and rain shadows.

It would be hard to find a species better adapted to survive disturbance. The thuya is one of the few resinous trees that will sprout vigorously if damaged

[*] In reference to the cedar forests of the High Atlas, Emberger, in *Aperçu général sur la végétation du Maroc*, p. 95, remarks that "la dégradation de la végétation dominante actuelle favorise l'extension du Pin d'Alep dans les régions où l'état antérieur de la végétation ne lui permettait pas de prendre pied."

[*] Kuhnholtz-Lordat, *op. cit.*, p. 121, cited in note 22: "Autour de la région méditerranéenne, on assiste depuis longtemps au mécanisme de la régression de la sylve originelle. C'est le Pin d'Alep qui y joue le rôle le plus important dans les paysages de substitution en raison de son aptitude à coloniser les terres dénudées, cultures abandonées, terrains incendiés."

[*] Not to be confused with the genus *Thuja* (arborvitae), another member of the cypress family.

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3

137 by cutting, browsing, or fire. This ability explains the presence of scrub thuya in deforested areas. But it grows slowly and is sensitive to disturbance in its early years. In the area delimited on the map, thuyas are widely scattered and for the most part badly mutilated. Large formations have been completely destroyed. More than half of the houses in the eastern part of the Rif have rafters of thuya, which is used, wherever it grows, as a source of charcoal. The Barbary thuya has been used for centuries in making cabinets and other furniture, and was esteemed by the Romans for roofing temples.[a] Damaged trunks sometimes develop giant burls, which have been used since classical time as table tops. A hard resin, sandarac, exudes from the trunks, and a modest quantity of it is shipped to Britain, where it is used in the manufacture of varnish.[b]

[a] Pliny, *Natural History*, XVI. 231, XXXIII, 146.
[b] W. Dallimore and A. Bruce Jackson, *A Handbook of Coniferae* (London: Edward Arnold, 1948), p. 610.

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3
Senhaja MX4

226 171 more important at that time than it is today. In chapter vii evidence will be presented to show that the same coastal area was once an important center of shipbuilding.

S 226 824 171 Fresh-water fishing seems to be restricted to a few streams in the mountains of Ghmara and Sanhaja as-Srair. The Sanhajans make use of the toxic roots of *Daphne Gnidium* (Arabic *mat'nan*) to stun fish, a practice that has been observed also in Sardinia, Portugal, and Spain.[a]

Utilization of Wild Plants

R 757 824 171 The average Moroccan woman can identify at least a hundred plants, and many are thought to have medicinal or magical qualities. To cure an ear infection, the ear is plugged with a mixture of butter and the ground leaves of *Ruta Montana*. The cure for a cold is to induce sweating by drinking milk or tea heavily seasoned with *Mentha pulegium*. A wound is cleaned with the leaves of *Inula viscosa*, and the leaves of other plants are worn under headgear to cure or prevent headaches, or in slippers to reduce fatigue. The number of similar ideas is limitless.

R 222 262 171 (139) Many wild plants have food value, and are collected even when regular harvests are bountiful. The list of such foods includes the seeds of several species of *Cistus* (*C. albidus, C. laurifolius, C. ladaniferus*), the sweet acorn of *Quercus Ilex*, the fruit of *Arbutus Unedo*, the roots of *Halimium lasiocalycinum*, and the berries of *Rubus ulmifolus* and *Crataegus laciniata*. Moroccans eat the bud of the palmetto. Acorns and *Cistus* seeds seem to be the most important famine foods.

Markets

R 484 171 It would be a mistake to conclude that rural communities in northern Morocco live in complete isolation. Moroccans are fond of travel, and the men, at least, have some time to satisfy their wanderlust each year. There are few men, even in the remote highlands, who have not visited at least one city. But when a Rifian or Sanhajan sets out for Fez or Tetuán he is likely to be more interested in sightseeing than in shopping. He may bring back a new cloak for himself or a piece of costume jewelry for his wife, but more often returns only with accounts of strange sights and tales of adventure.

R 438 439 171 A rudimentary system of trade does exist. A few manufactured articles are found in most homes, and some communities produce marketable goods. For example, the village of Mediuna, just south of Cape Spartel, is engaged in quarrying millstones from the Caves of Hercules.[b] Here they find a gritty conglomerate that is ideal for milling. The *m'allimin* (masters) who hew out these stones transport them on muleback to Tangier, whence they are traded throughout northern Morocco. Rifian women spend some time making pottery. During the idle months of winter, after the cereals have been harvested, Rifian men work on mats and baskets. Leatherwork is done at Taghzut, and winnowing forks are made at Ktama. Yet none of these activities seriously disturb the subsistence orientation of rural life. Specialization of this sort supplements but never supplants agriculture. The abiding concern of all tribesmen is with their fields.

R (113)

[a] R. F. Heizer, "Aboriginal Fish Poisons," *Smithsonian Inst. Anthro. Papers*, 38 (1953), 263.
[b] C. S. Coon, *The Seven Caves: Archaeological Explorations in the Middle East* (New York: Alfred Knopf, 1957), p. 45; E. Cecil Curwen, "Tangier Quern-Quarry," *Antiquity*, 119 (September, 1956), 174 and plate VII.

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3

seldom seen except in the European quarters of the larger towns. When a feast is in prospect, food is sometimes boiled in earthen pots set about an open fire. Wood fires also heat bake ovens. But most if not all Moroccan cooking is done over a charcoal brazier, consisting of an iron pot and tripod or simply an old gasoline tin. The brazier is used several times a day to boil water for tea; indeed, more fuel is consumed in this process than in cooking. Blacksmiths and other craftsmen rely upon charcoal, and lime kilns are found near every town.

Charcoal is a valuable fuel, for it has about twice the heating power of wood and burns without flame or smoke. In Morocco wood is converted to charcoal in shallow pits thinly covered with earth. But this process of partial combustion is extremely wasteful, since much of the volatile material in the wood is lost. The best charcoal is obtained from the denser hardwoods, especially the oaks. *Quercus Ilex* is the preferred wood, and this preference helps to explain the degraded aspect of most stands of this tree. The cork oak, the kermes oak, the oleaster, *Pistacia lentiscus, Rhus pentaphylla,* and *Arbutus Unedo* also yield excellent charcoal. Where the choice of wood is limited, many shrubs are utilized, and all available trees. No reliable estimate of the amount of charcoal annually consumed in northern Morocco has ever been published, but it must be enormous, for a charcoal brazier of some sort burns in every home.[34] During any day of the year, women and animals may be seen carrying loads of wood or charcoal to the cities and towns (pl. 8, *b*).

Mud brick or stone usually forms the walls of houses, but wood is always required for the rafters. In the deforested eastern sector, houses are built long and narrow so that branches and twigs can be used as a covering. When available, slender riparian or coniferous trees are used as rafters, but in most of northern Morocco such trees cannot be obtained.

Riparian forests are rare today apart from some canyons in the mountains, where the remaining stands of *Salix, Alnus, Populus, Vitex,* and *Crataegus* become thinner each year. *Nerium oleander,* the riparian "tree" of the hills and plains, is of little value in construction, and the oleaster and oaks are usually too massive or knarred.

The common type of house in Gal'aya and the Rif is well adapted to an environment poor in timber. In the Rifian dialect the word for "sloping roof" (*thazukha*) is the general word for all roofs, whereas a special word (*asthih*) is used for the now prevalent flat roofs.[35] The fact that the generalized word for roof is the same as that for a sloping one indicates greater antiquity for the latter variety. There is evidence that flat and narrow houses of the eastern type have recently replaced dwellings demanding more wood along the entire western frontier of the Rif.[36]

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most of this production has been consumed by factories in the Casablanca district and by the railroads of northern Africa. Fernand Joly *et al., Géographie du Maroc* (Paris: Delagrave, 1949), pp. 135–136.

[34] The estimate of "four to five metric tons" published by the Spanish forestry service takes account only of commercial operations. E. González Vázquez, *El Marruecos forestal* (Madrid: Ediciones Técnicas, 1945), p. 72.

[35] C. S. Coon, "Tribes of the Rif," *Harvard African Studies,* 9 (1931), 69.

[36] Coon, *loc. cit.*, traces this change to the burning of houses during feuds in the pre-protectorate period, and to the fact that many families found it difficult to obtain lumber after the end of Abd al-Krim's rebellion. For evidence of changes in recent years, compare his map of house types (p. 71) with fig. 15 of the present study.

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3

Plants that are somewhat resistant to fire or are stimulated to multiply and reproduce by fire have been called pyrophytes.[a] There are many kinds of pyrophytes, for resistance to or stimulation from fire may be achieved in several ways. The cork oak could be called a pyrophyte of passive resistance, for it is protected by thick insulating bark. Plants that send out new shoots after their aerial organs have been partly or completely destroyed might be described as pyrophytes of vegetative reaction. Budding may take place above ground, as in the thuya, or below ground, as in the kermes oak, palmetto, madrone, and numerous Mediterranean shrubs. Trees that cast deep shade (e.g., undisturbed holly oaks) could be termed pyrophytes of indirect resistance. Finally, some trees and shrubs that seed heavily and grow rapidly (e.g., Aleppo pine and species of *Cistus*) might be described as social pyrophytes.

This classification, derived from the pioneer work of Kuhnholtz-Lordat, has much to recommend it,[b] but, like all classifications, it has some faults. The passive resistance of the cork oak depends upon the lapse of time since the last stripping of the bark. Pyrophytes of vegetative reaction may be destroyed if fires recur in rapid succession. In northern Morocco it is hard to think of a good example of indirect resistance. Some stands of cork oak and holly oak have shaded floors and sparse underbrush, but during the dry season such formations may be inflammable. Again, although the Aleppo pine is an excellent pioneer, it may be exterminated if fires recur in rapid succession or if the young shoots are browsed.

Recurrent burning thus favors some plants and discourages others. Continuous repetition of brush fires produces communities rich in geophytes and therophytes. In much of northwestern Morocco, species of *Cistus* are the first shrubby pioneers.[c] They soon collect in extensive clumps, but die out after ten to fifteen years if not burned again. Large areas in Jbala and Ghmara, now covered with *Cistus monspeliensis*, *C. albidus*, and *C. ladaniferus*, probably were once covered with forests of cork oak or holly oak. Fires usually do not destroy the aerial organs of trees protected by thick bark, but the mortality rate rises sharply immediately after the bark has been stripped.[d]

When aerial organs are destroyed, both cork oak and holly oak reproduce from shoots. An occasional fire may even serve to regenerate a senile forest. But extreme care must be taken to prevent further destruction, for *Cistus*, *Erica*, and other heliophilous shrubs spread over the surface as soon as more light reaches the ground. Since the expanding secondary growth is highly inflammable, this process increases the danger of recurrent fires.[e] After several fires, the mesophytic plants are replaced by species more xerophytic as well as more heliophilous, indicating a change to drier soil conditions.[f]

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[a] Kuhnholtz-Lordat, *La Terre incendiée*, *passim*, cited in note 32.

[b] *Ibid.*, pp. 43 ff.

[c] Because of its rapid growth and abundant crop of seeds, *Cistus* has been used in California to protect denuded slopes. Gustaf Juhren, "The Use of *Cistus* in Erosion Control," *Lasca Leaves*, Spring, 1956, pp. 26–29.

[d] See also Boudy, *op. cit.*, I, 663 ff., cited in note 5; and A. Dugelay, "La remise en valeur des forêts de chênes-lièges incendiées." *Rev. Forestière Française*, November, 1951, pp. 687–694.

[e] Boudy, *op. cit.*, I, 649, describes *Erica arborea* as an "élément ignicole par excellence."

[f] On the effects of fire in similar environments, see A. W. Sampson, *Plant Succession on Burned Chaparral Lands in Northern California* (Berkeley: California Agricultural Experiment Station, 1944); R. S. Adamson, *The Vegetation of South Africa* (London: British Empire Vegetation Committee, 1938); W. B. Turrill, *The Plant Life of the Balkan Peninsula* (Oxford:

7:, Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3

372 The main difference between the effects of fire in broad-leaf forests and in
137 coniferous forests is that the latter, with the exception of the Barbary thuya,
311 do not reproduce by coppice shoots. The resinous bark of maritime and Aleppo pines is highly inflammable, and since neither tree reproduces from shoots, burning is usually fatal. Yet both species, especially the Aleppo pine, are pyrophytes. Indeed, the presence of a large number of pine seedlings is a sure indication of recent burning. Both species produce abundant seed, and proliferation is encouraged by the destruction of competitive growth. If fifteen or more years have elapsed since a fire, the seedlings reach maturity and the ground is again littered with seeds; but recovery is thwarted by more frequent fires.

Little is known of the effects of fire on the Moroccan fir, but it is probably unimportant as an agent of deforestation. The three main stands of fir grow on the highest slopes of limestone mountains, where there is little underbrush. Furthermore, these mountains do not have sufficient surface water to support permanent human settlement. Goats driven to the mountains from the lower slopes have destroyed many seedlings, but there is little evidence of destructive forest fires. Nor is there evidence of destructive fires in relatively undisturbed stands of cedar. Such forests have little underbrush to serve as kindling, and the cedar itself does not burn easily. But fires may be serious where cedar forests have been invaded by secondary growth. Most of the shrubs common in open stands of cedar—*Cistus, Daphne, Genista, Cystius, Thymus,* and *Halimium*—are highly inflammable. Occasional fires followed by long periods free of disturbance generally do not cause deforestation, but deforestation results when seedlings are destroyed before they can produce seed. The critical interval is disadvantageously long, for the Atlas cedar does not produce abundant seed until it is forty to fifty years old.

Destruction by Domestic Animals

233 It would be hard to overemphasize the destruction wrought by grazing and
311 browsing. More than half a million sheep and over a million goats are maintained in this zone. These figures are impressive, but the striking fact is that so large a number of animals are maintained by sedentary farmers. No tribe in northern Morocco is nomadic, and only the Ulad Stut and Aith Bu Yihyi practice transhumance. The main types of pastoral disturbance are well described by Braun-Blanquet.[*] Heavy pasturing causes: (1) withdrawal of large quantities of plant matter, (2) mechanical damage to plants by grazing, browsing, and trampling, (3) selective destruction of desired plants, (4) introduction of nitrophilous communities, and (5) alteration of micorelief.

The few cattle and camels kept in northern Morocco probably are not important agents of deforestation. Both animals are used almost exclusively for draft purposes, and few villages can afford to maintain more than one team. Authorities disagree on whether sheep have been significant factors in the process of deforestation. Most of the sheep in northern M[illegible] are in the drier and warmer parts of the zone, i.e., Garet and the eastern [illegible] Woody plants are too

(113) Clarendon Press, 1929); and B. O. Coventry, "Denudation of the Punjab Hills," *Indian Forest Records,* 14 (1929), 49–78.

[*] Braun-Blanquet, *op cit.*, pp. 367–368, cited in note 31.

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3

233 311 tough and massive to be adversely affected by grazing, but sheep can destroy shoots and seedlings, particularly those of the resinous trees.[a] The presence of monotonous formations of *Stipa tenacissima* in the lower Moulouya Valley and on the Algerian Hauts-Plateaux probably indicates overgrazing, for a history of excessive grazing may be inferred wherever hard tussock grasses have replaced more palatable growth.

Where goats are numerous, deforestation is accelerated, for no hillside is too steep to daunt this very agile creature, and few plants escape its voracious appetite (pl. 8, *a*). In Arcila, goats scale the nearly vertical Portuguese walls, and in the Sous Valley they climb into *Argania* trees. Not content with the grazing of grass, goats tear it up by the roots. When woody browse is exhausted, the soil itself is grazed in an attempt to get at the seeds of grasses and other plants. It is not surprising that the goat should be described as an "ecologic dominant,"[b] and that many naturalists would like to see it become extinct, except in zoos.[c]

[372] The most serious deforestation occurs when heavy browsing follows burning. Premature browsing or grazing results in the destruction of seedlings before they can produce a new crop of seeds. The French forestry service has ruled that burned areas should be closed to pasture for at least six years. The recovery of cedar forests may be thwarted if excessive browsing takes place within twenty years.[d] The best-known relict of the cedars of Lebanon, a stand of several hundred trees, is protected from vandalism by a church and from goats by a stone wall.[e] In open places in the Mamora forest, young cork oaks survive only within a protective cluster of palmetto. On the semiarid plains of northeastern Morocco, *Pistacia atlantica* rarely survives unless it is protected by a spiny hedge of zizyphus or sumac (*Rhus pentaphylla*), and in the Sous Valley the latter species plays an even more vital role as a protector of young *Argania* trees. In the mountains of northern Morocco, seedlings of cedar, pine, and fir are protected by the armature of the juniper. Elsewhere on the Mediterranean versant, young trees may be protected by *Genista, Calycotome, Ulex,* and other thorny Leguminosae.

311 233 372 139 Trees that reproduce by coppice shoots are seldom completely destroyed, but excessive browsing may reduce them to shrub form. In the geographic textbooks the scrub or dwarf state of the Mediterranean woodland is often described as a consequence of the Mediterranean precipitation regime. The error of this generalization is manifest in the holly oak. That the stunted and deformed appearance of this tree results from fire-induced sprouting and browsing is evident when stately trees growing on protected sites are compared with the prevalent forms. Neither climate nor any other element of the inanimate environment can explain

[TEXT CONTINUED ON PAGE 107]

[a] Boudy, *op. cit.*, I, 616, is more emphatic: "Il est d'observation courante au Maroc, comme en Algérie, que dans tous les massifs de résineux où le parcours des moutons est intense, il n'y a pas de régénération et que ces massifs sont condamnés à disparaître à plus ou moins longue échéance."

[113] [b] Marston Bates, "Man as an Agent in the Spread of Organisms," in Thomas, *op. cit.*, p. 798, cited in note 7.

[113] [c] Raymond Furon, "The Gentle Little Goat: Arch Despoiler of the Earth," *The Unesco Courier*, January, 1958, pp. 30–32.

[d] Cf. Boudy's comment, *op. cit.*, II, 532: "Régénération de la cédraie et pâturage sont choses incompatibles." The prerequisites of recovery probably include at least three or four years of unusually heavy precipitation.

[113] [e] W. C. Lowdermilk, "Lessons from the Old World to the Americas in Land Use," *Smithsonian Inst. Ann. Rept. 1943* (Washington, D.C., 1944), p. 416.

A, [See p. 132--Analyst]

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3
Jebala MX2
Senhaja MX4

S
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A. Sidi al-Hajj Yacub (Aith Seddath)

J
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B. Sidi Mahadri (near Tetuán)

J
R
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C. Km. 194, Tetuán–Melilla route

J
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D. Km. 55, Tangier–Larache route

000

E. Bani Dercul F. Sidi Loraichi (Bani Arus)

Fig. 25. Profiles of vegetation on sacred sites.

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3
Jebala MX2
Senhaja MX4

the stunted form of this tree. The same remarks apply to dwarf forms of thuya and oleaster. On protected sites even the palmetto may become a tree and, when disturbance is manifest, dwarf forms of cedar develop.

Vegetation on Sacred Sites

Throughout Morocco and to some extent elsewhere in the Muslim world, cemeteries are regarded as sacred ground. Sanctity is ascribed also to the areas adjacent to tombs or shrines of saints (*murabitin*). The cult of saints has been an important factor in Moroccan history, and tombs or shrines are found in the territory of each tribe.[a]

Sacred sites often constitute islands of verdure. This correlation is not unique. In *The Golden Bough* Sir James Frazer describes sacred woods in many parts of the world.[b] The interesting feature of the Moroccan situation is that such groves are extraordinarily numerous and that the veneration relates to the ground in which plants grow and not to the plants themselves.[c] Protected growth is usually more dense than the growth on adjacent profane land, and the height and girth of individual plants exceed those of plants growing on unprotected land. Some species (e.g., *Pistacia lentiscus* and *Chamaerops humilis*) rarely achieve arborescent forms on unprotected sites.

The nature of the protected growth varies from a single shrub or tree to thickets and groves. Figure 25 shows the silhouettes of vegetation on a few sacred sites. These examples, selected from hundreds, illustrate the general pattern (cf. pl. 9, *a* and *b*).

Figure 25, *a*, shows a few mature cedars surrounded by a dense growth of holly oak. The prevalent vegetation in this area is a shrub formation dominated by *Cistus laurifolius*. There are no other cedars within a radius of several hundred meters, and holly oaks, apart from those on sacred sites, are in scrub form. It is evident that succession has resulted in a retrogression from cedar to oak forest and then to a sparse cover of shrubs.

Figure 25, *b*, illustrates a protected formation dominated by oleasters (cf. pl. 9, *a*). *Pistacia lentiscus* becomes prominent where oleasters are widely spaced and light reaches the ground freely. Palmetto and thuya, even more heliophilous, are confined to the edges of the protected growth. In the surrounding area the vegetation is limited to shrubs. Numerous other examples of oleaster groves fringed with pistacia and palmetto could be described. A handsome grove appears at the tomb of Sidi Manari on Cape Malabata opposite Tangier. Five groves appear on one ridge between Tangier and Tetuán. Others appear on the marine terraces between Tangier and Arcila, and on the lower slopes of the limestone mountains

[TEXT CONTINUED ON PAGE 110]

[a] E. Lévi-Provençal, "Marabout," in H. A. R. Gibb and J. H. Kramers, eds., *Shorter Encyclopaedia of Islam* (Leiden: E. J. Brill, 1953), pp. 325–326; Emile Dermenghem, *Le Culte des saints dans l'Islam maghrébin* (Paris: Gallimard, 1954); Edward Westermarck, *Ritual and Belief in Morocco* (London: Macmillan and Co., Ltd., 1926).

[b] Sir James Frazer, *The Magic Art and the Evolution of Kings* (New York: The Macmillan Co., 1935). Part I of *The Golden Bough*.

[c] J. Cola Alberich, *Cultos primitivos de Marruecos* (Madrid: Instituto de Estudios Africanos, 1954), refers to tree worship (*dendrolatría*), but the evidence he cites relates to popular ideas of the medicinal and magical qualities of plant material (leaves, seeds, acorns, etc.) and not to the sanctity of plants as such. It is possible, for example, to recognize magical qualities in pine cones and yet have no reluctance to destroy or mutilate pine trees. In Morocco the important consideration is not what qualities a plant may possess but *where* it grows.

[See p. 133--Analyst]

7: Mikesell K-4,5 (1955-1957) 196I

MX3 Rif MX3
Jebala MX2
Senhaja MX4

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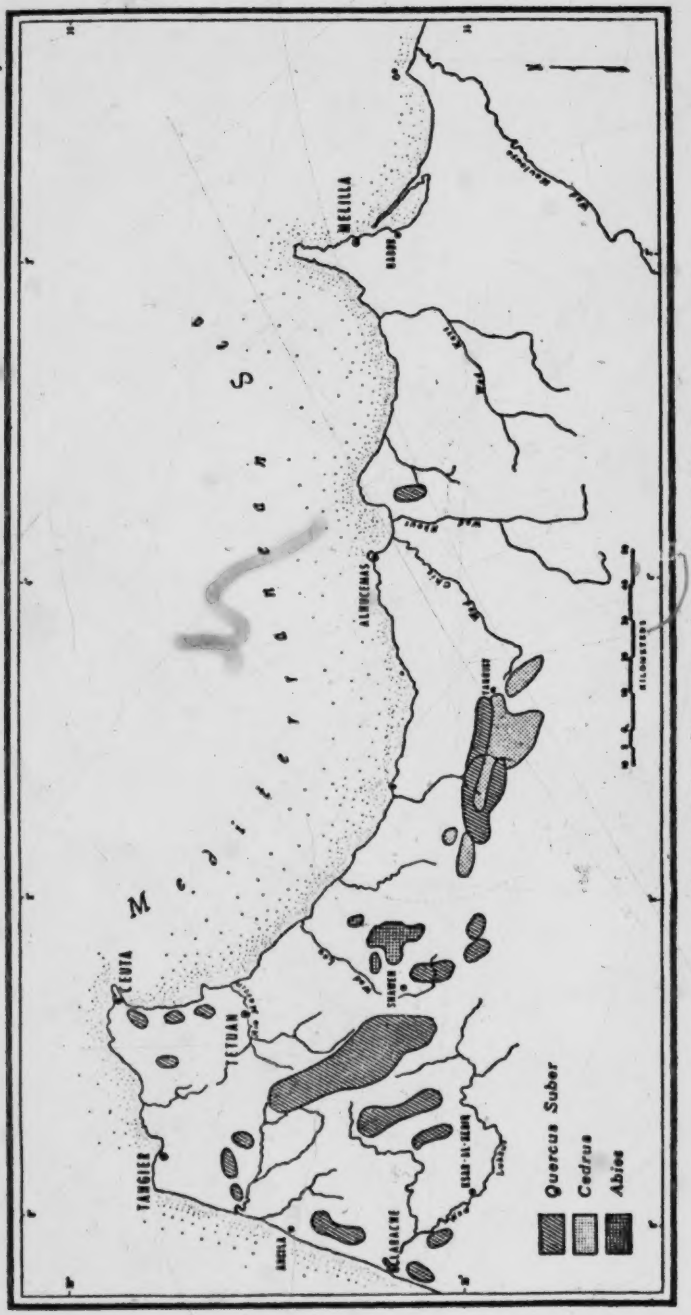

Fig. 20. Northern Morocco: present distribution of forest.

/p. 108/

7: Mikesell K-4,5 (1955-1957) 1961

MX3 Rif MX3
Jebala MX2
Senhaja MX4

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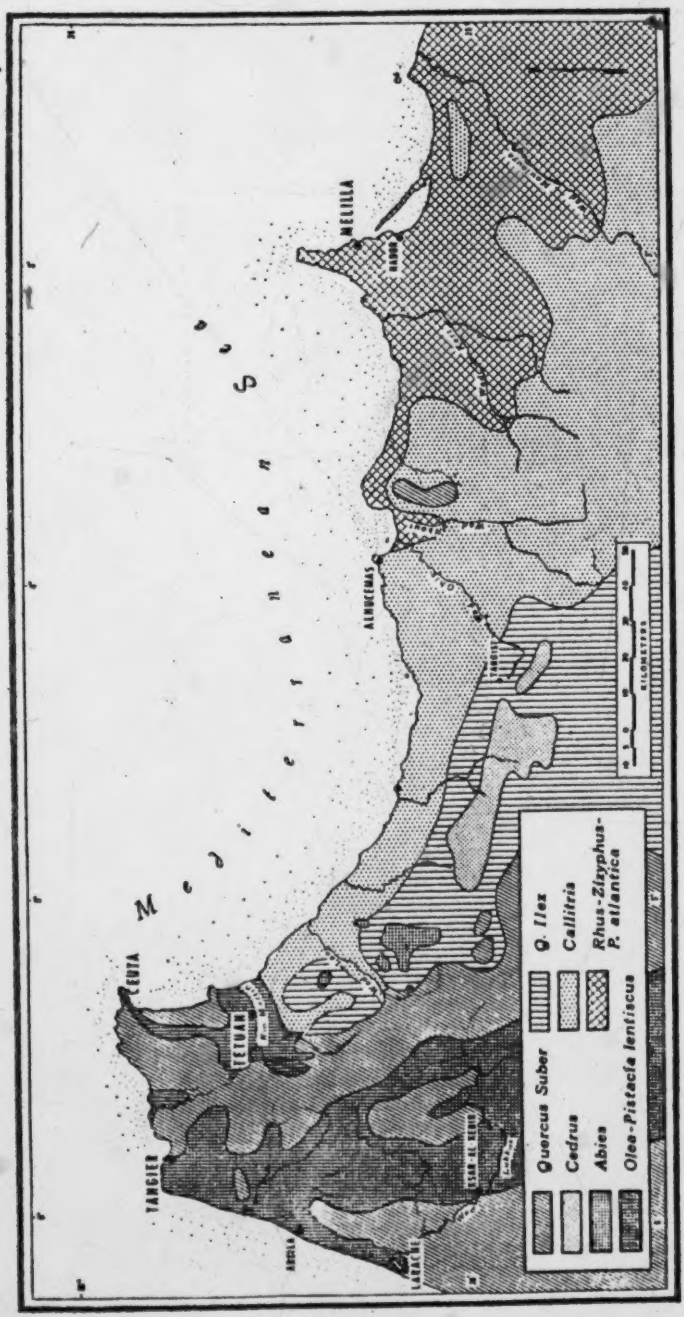

Fig. 27. Northern Morocco: inferred primordial distribution of forest.

/p. 109/

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3
Jebala MX2

south of Tetuán. There are at least a hundred oleaster groves in the area west of Ceuta and Ksar al-Kebir. In some areas oleasters mark every cemetery. Faced with this evidence, we can hardly avoid the inference that the primordial cover of the lowlands of northwestern Morocco was a woodland formation of oleaster and pistacia, and that the present cover of palmetto scrub represents degradation.

Figure 25, *c*, shows a protected stand of holly oak. The central part of the sacred grove consists of tall trees. *Pistacia lentiscus* and *Juniperus Oxycedrus* form a ring around the protected trees. Holly oaks are scattered throughout the central highlands (cf. fig. 8), but closed stands similar to the one depicted here are found only on sacred sites.

In figure 25, *d*, the evidence suggests, not a retrogression from forest species to scrub, but, rather, that two species which usually appear as shrubs, *Pistacia lentiscus* and *Chamaerops humilis*, may have an arborescent form. The density of the protected formation and the height of its components differ markedly from the scrub cover of the surrounding land.

The cluster of cork oaks shown in figure 25, *e*, is preserved in an area of extensive clearing. Most of the nearby land has been burned during the last decade. The only conspicuous plants are *Cistus monspeliensis* in fallow fields and *Nerium oleander* along stream channels. This cluster of trees gives some indication of the plant cover of the area before it was cleared, and indicates the course of regeneration (cf. pl. 9, *b*).

In figure 25, *f*, a shrine is marked by two plants, an oleaster and a fig tree. This sketch illustrates on a small scale what the others show in greater detail. Most of the area surrounding the shrine is cultivated. Fallow fields are covered with *Asphodelus microcarpus*, *Urginea maritima*, and palmetto. The nearest oleaster, seven kilometers away, also grows on a sacred site.

Extent of Deforestation

Trends in plant ecology, viewed in the light of human relationships, take one of two courses, improvement or deterioration. The evidence examined thus far clearly indicates deterioration. What is the magnitude of change? This question cannot be answered in detail. Change is perceived through comparison, and the only reliable source of plant data is the visible pattern of today. Figure 26 gives a synoptic view of the distribution of forest. Figure 27, the basis for comparison, shows inferred primordial or potential forests. The first map is objective; it is a cartographic record of the distribution of forest in the sixth decade of the twentieth century. The second map is subjective, and its usefulness is conditioned by the quality of the evidence presented thus far.

The details of these maps are less important than their general outlines. The implication is clear that the present wooded area constitutes only a small part of the primordial forest. Many forest species, now stunted and widely spaced, may once have been taller and more closely spaced. Under undisturbed conditions the exceptionally xerophytic or heliophilous species would probably be confined to sunny slopes in the western sector or be limited to the semiarid eastern plains. Under optimum conditions the area covered by pyrophytic shrubs would be greatly reduced, and there is no reason to believe that the primordial cover

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3

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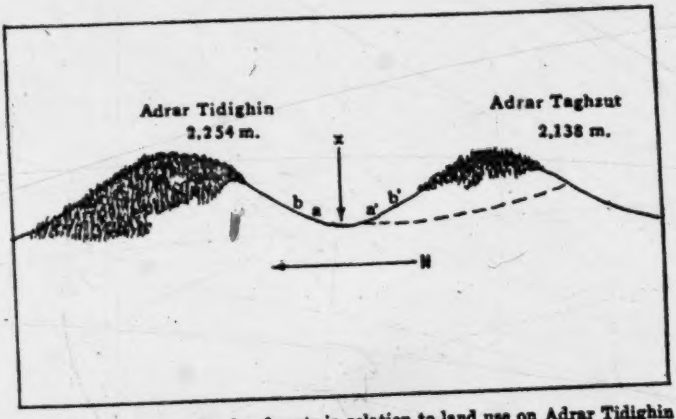

Fig. 28. Position of cedar forests in relation to land use on Adrar Tidighin and Adrar Taghzut: *a*, *a'*, zone of irrigated terraces; *b*, *b'*, zone of dry farming; *x*, location of protected cedar.

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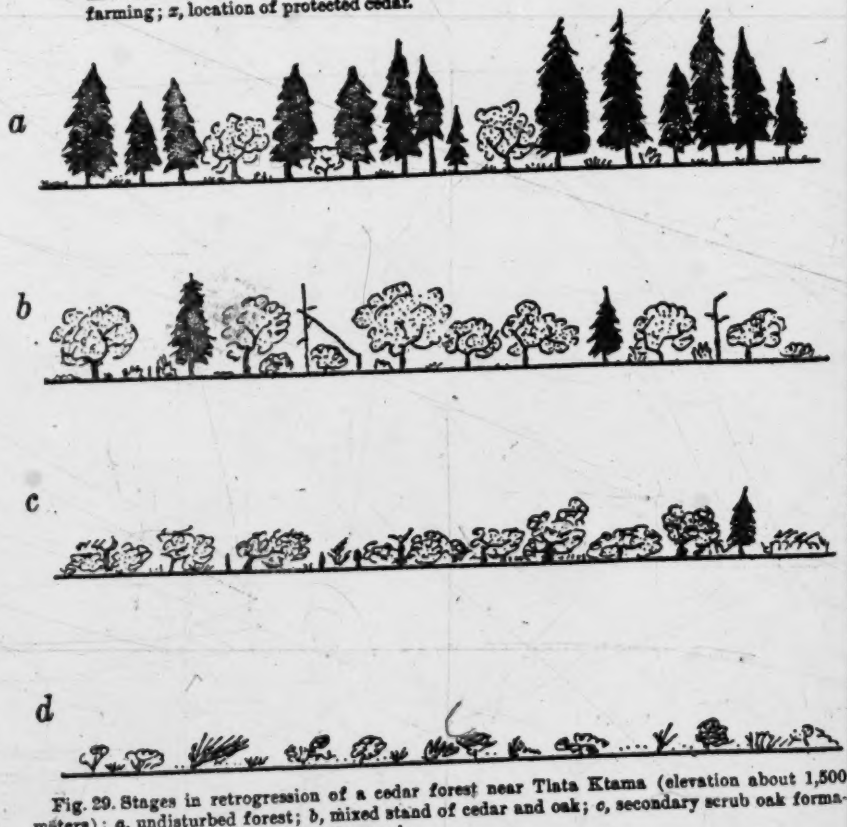

Fig. 29. Stages in retrogression of a cedar forest near Tlata Ktama (elevation about 1,500 meters): *a*, undisturbed forest; *b*, mixed stand of cedar and oak; *c*, secondary scrub oak formation; *d*, tertiary scrub formation without oak.

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3
Jebala MX2
Senhaja MX4

bottoms of valleys, low nocturnal temperatures, caused by air drainage, probably favor the cedar; nevertheless, on many slopes the forest line appears to be 300–500 meters above its natural position.

Cedar forests do not regenerate unless pasturing is suppressed and there is an opportune cycle of wet years. Moreover, the subsoil and parent material must be loose enough to favor the development of seedlings and yet compact enough to retain moisture. A further prerequisite is that there must not be a thick cover of competitive shrubs. A single deforestation may drastically upset the natural equilibrium; if disturbance continues, recovery may be impossible. The mantle of cedars on relatively inaccessible slopes gives some indication of the appearance of the primordial forest (pl. 10, *a*). Figure 29 shows the trend of retrogression. On gentle slopes, undisturbed stands are dense, dark, and relatively free of underbrush. Steeper slopes, exposed to greater insolation, have an understory of shrubs and oaks. Burning or cutting followed by pasturing eliminates the cedar and reduces the oaks to scrub form. If disturbance continues, the plant cover degenerates to a sparse scrub of *Genista quadriflora, Juniperus Oxycedrus,* and *Cistus laurifolius.*

It is difficult to delimit the primordial pattern of the cedar forests. Forests probably existed on Jbil Kelti (1,927 meters), Jbil Sugna (1,600 meters), and Jbil Buhashim (1,681 meters), for a few cedars still grow on these peaks. The absence of cedars from Jbil Khsana (1,695 meters) is puzzling, since this peak receives abundant precipitation, and is composed of sandstone and schist, which weather into deep soils. At present no cedars appear east of Adrar Tizi Ifri, but they may once have clothed the highest peaks of the eastern Rif, including Adrar Hamam (1,930 meters) and Azru Akchar (2,011 meters). It cannot be proved that the cedar once grew beyond its present range, but the pattern of succession suggests that some stands may have been completely destroyed.[*]

The theory was presented, in chapter ii, that both the Aleppo and the maritime pine may be relicts which have been encouraged to advance by the destruction of competitive growth. If this notion is sound, the area originally covered with pines must have been even smaller than the present stands. This interpretation helps to explain the presence of pines in degraded forests of cedar and fir. However, human interference has probably caused a reduction of some stands of Aleppo pine, particularly on the Melilla peninsula and in the mountains southeast of Shawen. Disturbance might initially have encouraged expansion and then forced a new retreat. It is difficult to enlarge on this idea, for the existing stands of pine are too small and widely scattered to be placed accurately on the maps.

Prolonged disturbance and exploitation of the Barbary thuya have diminished the density of the remaining stands and reduced many trees to shrub form. The natural range of thuya in the western half of the zone can be traced without much difficulty. At higher altitudes on the Mediterranean versant, increased precipitation and lower winter temperatures favor cork oak and holly oak. On the Atlantic versant, climatic factors alone delimit the range. It is more difficult to trace a

[*] Louis Emberger, *Aperçu général sur la végétation du Maroc* (Bern: Hans Huber, 1939), (ref. to map), seems to regard the primordial range of the cedar as essentially the same as the present range. Ruiz de la Torre, *El matorral en Yebala,* pp. 22–23, cited in note 41, suggests a natural extension to include the highest peaks of Ghmara and Jbala.

[See p. 134--Analyst]

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3

limit in the area east of Wad Nkour. Emberger believes that most of the eastern lowlands were once covered with thuya.[111] According to another study, undertaken by an engineer of the Spanish forestry service, the natural range of the thuya extended to all areas of residual soil from the Nkour Valley to Wad Moulouya.[112] These interpretations may be sound, but the evidence presented here suggests that the primordial cover of most of the eastern sector was a mixed formation of *Pistacia atlantica* and *Rhus pentaphylla* with scattered clumps of oleaster. The effect of prolonged disturbance has been to reduce the area covered by these species and to favor the expansion of alfa grass (*Stipa tenacissima*), dwarf sage (*Artemisia Herba alba*), and camel thorn (*Zizyphus lotus*).

There has been no study of plant succession in the arid and semiarid parts of northern Africa comparable in scope to Aubréville's monumental treatise on the effects of burning, clearing, and pasturing in tropical Africa.[113] Deterioration of ranges and "xerophytism" have been reported for most of the pre-Saharan zone, but it is not yet possible to determine the extent of change. The American statesman-scholar George P. Marsh argued long ago "that forests would soon cover many parts of the Arabian and African deserts, if man and domestic animals, especially the goat and camel, were banished from them."[114] In recent years a number of French scholars have expressed doubts concerning the theory that the vast formations of alfa grass and dwarf sage on the Algerian plateaus developed as a result of the semiarid climate.[115] After careful study of scattered stands of *Acacia gummifera* on the arid littoral of Morocco, south of Agadir, Charles Sauvage questions whether the zone between Anti Atlas and Wad Dra should be described as asylvatic.[116] Basing his conclusions on the wide occurrence of acacias in the desert, one author speaks of the primordial forests of the Sahara.[117] Sixty years ago another naturalist discovered that many of the wadis in the Egyptian desert were named after trees that had since disappeared.[118] Thus we have evidence that the effects of human disturbance have been felt even in the Sahara, and that aridity does not prevent the growth of some trees.

In the semiarid sector of northern Morocco it is possible to reconstruct vegetational changes with the aid of relict formations preserved on sacred sites. At the shrine of Sidi Seddic, on the border of the territories of Ulad Stut and Aith Bu Yihyi, a majestic oleaster, surrounded by sumac, is in striking contrast to the prevalent cover of dwarf sage. *Pistacia atlantica*, one of the few trees of northern Africa that can grow on heavy alluvial soils, appears on several sacred sites in

[111] Emberger, *Aperçu général sur la végétation du Maroc*, pp. 71–78.

[112] J. Ruiz de la Torre, "La vegetación natural del norte de Marruecos," *Notes Marocaines*, 9–10 (1957), 30–33.

[113] André Aubréville, *Climats, forêts et désertification de l'Afrique tropicale* (Paris: Editions Maritimes et Coloniales, 1949).

[114] George P. Marsh, *The Earth as Modified by Human Action: A Last Edition of "Man and Nature"* (New York: Scribner's Sons, 1885), p. 149.

[115] According to Emberger, *Aperçu général sur la végétation du Maroc*, p. 68, "Les prairies d'halfa peuvent représenter d'anciennes forêts de *Juniperus phoenicia*, parfois même de *Callitris* et même de *Quercus Ilex*." Buffault, "Le déboisement de l'Afrique du Nord," p. 481, cited in note 15, also accepts the notion of a primordial forest on the Hauts-Plateaux.

[116] Ch. Sauvage, "Les environs de Goulimine: carrefour botanique," in *Volume jubilaire de la Société des Sciences Naturelles du Maroc* (Rabat, 1948), pp. 107–146.

[117] L. Lavauden, "Les forêts du Sahara," *Rev. des Eaux et Forêts*, 65 (1927), 263–277.

[118] E. A. Floyer, "Disappearance of Desert Plants in Egypt," *Kew Bull. Miscell. Information*, 72 (1892).

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3

the valleys of Wad Moulouya and Wad Kert.[*] The Aleppo pines preserved on the Melilla peninsula tell a similar story of general destruction and rare survival. Elderly tribesmen of Ibdharsen, Aith Bu Yihyi, and Ulad Stut remember a time when great thickets of sumac covered the plains of Garet.

The evidence examined in this chapter supports the thesis, now accepted by most students of Mediterranean vegetation, that the prevalent maqui and garrigue formations are produced and maintained by man. The pattern of succession in the drier eastern sector of northern Morocco depends upon ecologic processes that are not yet thoroughly understood. The theory that this area was once wooded may or may not be sound, but there is no reason to believe that the primordial cover included a high proportion of tussock grass, zizyphus, or other animal-resistant plants. Any projection of current trends, whether in the drier or the wetter areas, suggests a large degree of change. This introduces new problems, for the inevitable result of biotic disturbance is a modification of the soil.

Erosion

The steep slopes of northern Morocco favor rapid runoff and prevent the formation of deep residual soils. Moreover, torrential rains in winter and spring follow vigorous mechanical weathering during the dry summer months. It would be hard to imagine an area more vulnerable to destructive erosion. Few slopes have an adequate plant cover, and forest now covers only about a tenth of its primordial range. In view of these natural and artificial conditions, it is not surprising that soil forms a deep and continuous mantle only in the coastal plains, and that most of the highlands are bare.

A useful point of departure is to locate areas that are virtually without soil. This is the situation in the calcareous highlands. From Jbil Musa to Ibuqquyen the horizon is dominated by a wall of bare limestone. It is possible that soil never was formed on the steepest slopes. On moderate slopes there are small and discontinuous patches of clay, but most of the calcareous zone has been stripped of fine material and only cobbles remain. Here and there are tiny mounds of soil preserved by the roots of a palmetto (pl. 11, *b*). On some slopes, particularly in the range of Jbil Kelti, lines of stone have been built up when there was enough soil to justify clearing and cultivation.

The rate of erosion in any storm depends on the force with which raindrops stir up the soil and the amount and speed of the runoff. Deforestation, particularly on steep slopes, accelerates degradation, and the combination of cutting, burning, and browsing prevents any reëstablishment of protective cover. Although the calcareous highlands were probably once covered with forests of holly oak (cf. figs. 5 and 27), today, vast areas lack even herbaceous growth. In the karstic highlands the only conspicuous plants are palmetto and spiny gorse (*Ulex parviflorus*).

Erosion is not quite so serious in the highland areas formed of schist and sandstone. Protected stands of cedar, cork, and deciduous oaks are associated with abundant litter and about eighteen inches of clay or sandy loam. But in cleared areas there is abundant evidence of loss of topsoil (pl. 10, *b*). Since it is common

[*] *Pistacia atlantica* has been used to stabilize slopes in Israel. G. F. Gindel, "Afforestation of the Semi-arid and Arid Areas in Palestine," *Empire Forestry Rev.*, 25 (1946), 213–221.

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3
Jebala MX2

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a. Mutilated cork oaks in an area overrun with goats.

J
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b. Jbalan woman with a load of firewood.

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3

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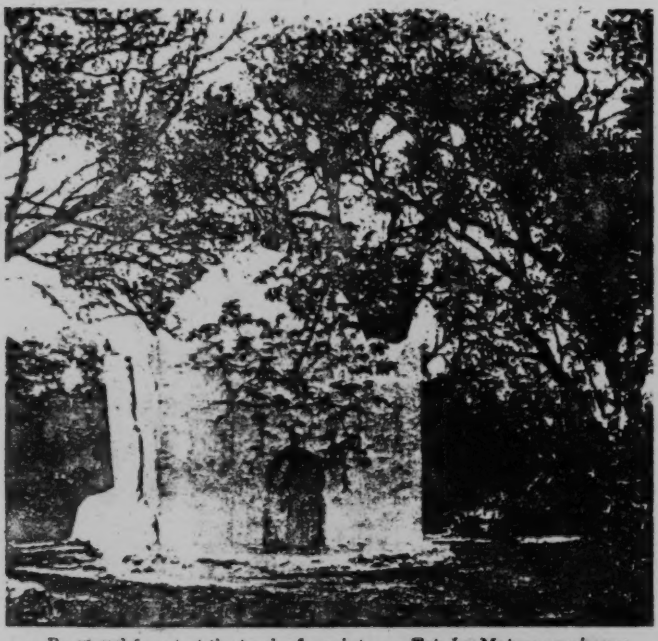

a. Protected forest at the tomb of a saint near Tetuán. Mature specimens of *Olea, Callitris,* and *Pistacia lentiscus.* Cf. fig. 25, *b.*

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b. Sacred clump of cork oak on the site of a shrine near Shawen. *Cistus monspeliensis* appears in foreground.

7: Mikesell K-4,5 (1955-1957) 1961 MX3 Rif MX3

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a. An active gully in the eastern Rif (Aith Said).

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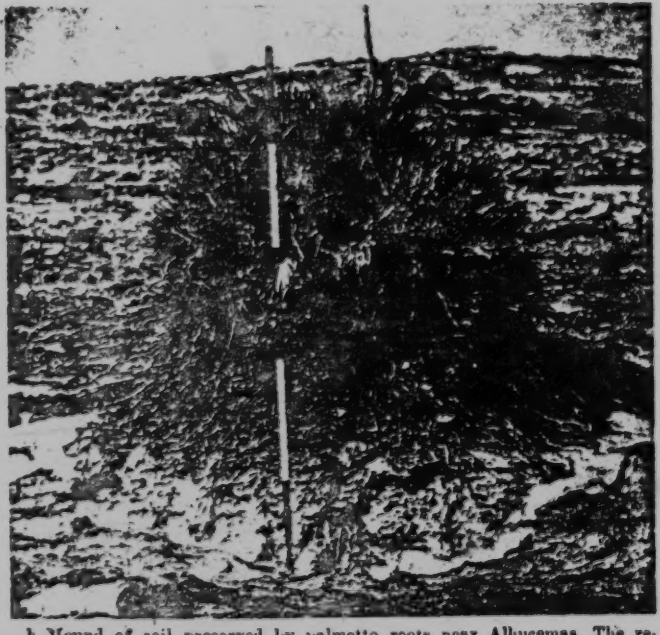

b. Mound of soil preserved by palmetto roots near Alhucemas. The remainder of the slope has been eroded down to limestone bedrock. (Each unit of scale is equal to one foot.)

1;Coon E-5 (no date) 1951 M1 Middle East
Rif 1003
[Village of Ubd 'Abd al-Mumin]

had died by the rifle, and many of their brothers as well. Some provision must be made for young widows and their helpless children. To the human population of fifty-seven was added an animal roster of one hundred and twenty-five head: 10 cows, 1 calf, 15 sheep, 80 goats, 1 donkey, 2 mules, and 16 dogs. Six of the men owned the goats, and one the sheep; three men had none. Each man, however, owned a cow, for all needed milk.

There were a total of 923 food-bearing trees—more than 16 to a person, or 92 to a family. These were divided as follows: almonds, 525; figs, 272; olives, 71; pomegranates, 33; apricots, 16; oranges, lemons, and walnuts, 2 of each. Every man owned at least 4 almond, 15 fig, and 3 olive trees. Dried almonds and figs are absolutely necessary to sustain life in late winter once the grain has been eaten, while olive oil is the essential fat. The other kinds of trees produce useful fruits, but the Riffians can get along without them.

In these high valleys arboriculture is the main business of the people, and they prune, water, graft, and fertilize their trees with extreme care. Compared to this activity the Riffian spends but little time in his fields; he owns enough tillage for only about four weeks' plowing time a year, with a range of from twenty to forty-five days among the ten men. Those who have little are hired to work for those who have more, on the ancient system of granting a fifth to the plowman. Work on the vegetable gardens rates a fourth, while he who cares for another man's trees receives a third of the fruit, aside from windfalls which are for women, children, and the poor.

Unfruitful trees have long ago been felled to make way for the silver-leaved olives and the lofty walnuts. Up high on the ridges to either side one can still cut cedar and even a few pine. Below the man-made tree line is a zone of brushy goat pasture, and below this, but still steep, the vineyards. Here the families gather in September to pick the grapes, which they dry into raisins to be eaten with the figs and almonds. Up the valley a way there are two public installations, a small turbine water mill of familiar appearance, which belongs to the grandsons of its builder, and an olive press, which serves several villages. This olive press is actually near the center of another village, inhabited by holy people who never fight. Their holiest member regulates the protocol of olive pressing, aside from serving as imām to lead the Friday prayer, in which the grown men of all the villages of that part of the valley participate.